



NDCEE

National Defense Center for Energy and Environment

2009 ANNUAL REPORT



Technology Transition—Supporting DoD Readiness, Sustainability, and the Warfighter

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NATIONAL DEFENSE CENTER FOR ENERGY AND ENVIRONMENT

For almost 20 years, the NDCEE has served as a national leadership organization to address high-priority environmental, safety, and occupational health challenges for the Department of Defense (DoD), other government organizations, and the industrial community.

The NDCEE's mission is to support DoD sustainability and readiness through:

- Applied research and development, where appropriate, to accelerate the transition of new technologies
- Demonstration and transition of environmentally acceptable materials and processes to defense industrial activities and private industry
- Training that supports the use of new, environmentally acceptable technologies



**DoD Executive Agent
Office of the
Assistant Secretary
of the Army (Installations
and Environment)**

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A MESSAGE FROM THE EXECUTIVE AGENT



"The NDCEE is a valuable resource to DoD as well as other federal agencies. In 2009, the NDCEE assisted DoD in identifying, researching, demonstrating and validating emerging and existing technologies that address a host of requirements as well as capability gaps. The NDCEE impacted a multitude of activities across the broad spectrum of operations, training, acquisition, and installation management programs. The NDCEE provided reliable, sustainable, and cost-effective solutions in areas ranging from

contingency operations to global climate change and greenhouse gas reduction goals to safety and occupational health. These solutions increased mission readiness and sought to improve the health and safety of our Armed Forces both at home and abroad. Further, many of the tools the NDCEE provides to DoD directly impact quality of life issues for our military personnel and the civilian workforce, while at the same time go a long way toward enhancing efficiencies and cost effectiveness of the core enterprises of the military departments."

*— Tad Davis, Deputy Assistant Secretary of the Army
for Environment, Safety, and Occupational Health, and Department of Defense
Executive Agent for the National Defense Center for Energy and Environment*



SUPPORTING DOD READINESS, SUSTAINABILITY, AND THE WARFIGHTER

The NDCEE advances and transitions solutions that address both stand alone and integrated environmental, safety, occupational health, and energy (ESOHE) challenges impacting installations, weapons systems, operations, and the warfighter. These solutions vary as much as the nature of the issues, ranging from traditional materials, processes, and hard technologies to information systems, decision-support tools, and public engagement protocols. New technologies and approaches are needed to solve complex and often interrelated challenges, and the NDCEE strives to implement a multi-disciplined sustainability perspective that recognizes these relationships. This Annual Report highlights NDCEE accomplishments for Fiscal Year 2009 (FY09).

ENABLING THE TRANSITION TO ALTERNATIVE ENERGY SOLUTIONS

The NDCEE continues to support the development, demonstration, and transition of technologies that minimize energy consumption, optimize the use of renewable energy sources, and provide high quality living and working environments. In FY09, our ongoing policy and analysis efforts contributed to the development of the Army's Energy Security Goals and Army Energy Security Implementation Strategy. In support of these and other DoD and Service energy directives and sustainability goals, FY09 technology demonstration initiatives included wind turbines at the Navy's Pearl City Family Housing Site, solar thermal radiant heat flooring at the Marine's Pohakuloa Training Area, and several technologies to improve energy results for Army family housing at Aliamanu Military Reservation, all in Hawaii. Reducing energy use was also the focus of a geothermal heat pump system demonstration initiated at Fort Indiantown Gap. The NDCEE developed and demonstrated a measurement tool for greenhouse gas emissions and is conducting testing of biodiesel in tactical vehicles. Knowledge captured and communicated from these diverse efforts is enabling fielding of alternative energy solutions throughout DoD facilities and weapons system platforms.

"Partnering with NDCEE has given us an opportunity to investigate and validate new sustainable strategies, which we can implement at Army Hawaii Family Housing and at our other military housing developments. Initiatives like this help us provide energy-efficient homes to our military families and develop effective tools to communicate conservation awareness. Success in this program will free project funds for improving community programs that can enhance the quality of life for our Service Members and their families."

-Claire Ridding-Johnston, Project Director, Actus Lend Lease

MEASURABLY IMPROVING HEALTH, SAFETY, AND READINESS

The NDCEE provides support to two key DoD readiness programs targeted at enhancing warfighter well-being and the health and safety of military workplaces: initiatives supporting the Defense Safety Oversight Council (DSOC) and the DoD's Voluntary Protection Programs Center of Excellence (VPP CX). In FY09, DSOC Task Forces guided the NDCEE project teams as they developed information management tools focused on reducing airspace mishaps; demonstrated and validated a field injury tracking tool; developed and tested fitness awareness tools for injury prevention during Basic Combat Training; and developed training to reduce risks for firefighters.

The NDCEE responded to warfighter needs in partnership with the U.S. Army Center for Health Promotion and Preventive Medicine by researching and testing a technology to reduce back injury caused by vibration exposure. These NDCEE activities contributed to measurable improvements in baseline DoD Safety Incident Metrics in FY09 including: 41% decrease in Civilian Lost Day Rate; 12% decrease in Private Motor Vehicle (PMV) Fatality Rate and 88 lives saved from PMV mishaps; and 43 lives and 50 aircraft saved from aviation accidents.

"The support provided by the NDCEE is the highest quality. The NDCEE Team has provided outstanding Program Management for the PMV Task Force and our initiatives stay ahead of or on schedule. I appreciate all of the NDCEE's support as we continue to pursue all types of solutions to the complex problems involving personal motor vehicle mishaps."

- Major General Fred Roggero, Air Force Chief of Safety

REDUCING THE ENVIRONMENTAL FOOTPRINT AND OPERATIONAL COSTS

Reducing the environmental footprint and costs associated with the management of installations and weapons system acquisition, operation, and maintenance continues to be a focus area for the NDCEE. For example, to reduce costs associated with range maintenance, in FY09 the NDCEE validated a soil sampling method that is both more accurate and more economical than traditional methods. NDCEE support of DoD industrial base operations included conducting facility baseline assessments in support of modernization initiatives, demonstrating and fielding multiple alternative coating and coating removal technologies, and conducting material compatibility testing of commercial anti-icing materials to reduce the use of propylene glycol in aircraft deicing operations. In addition to these technology demonstration and transition examples, the NDCEE also provides analysis and insight regarding emerging contaminants or pending regulations, which allows the DoD to be proactive rather than reactive. In FY09 the NDCEE provided Risk Management Options based on the evaluation of costs and impacts associated with the use of beryllium and naphthalene; these were endorsed by the Emerging Contaminants Governance Council. These and other on-going NDCEE efforts provide the DoD with cost-effective, leading edge solutions to address priority environmental and operational challenges.

"The NDCEE did a bang up job with its baseline facility assessment. This assessment will help the Army to optimize Army Ammunition Plant assets and make better informed decisions. Well done, responsive, and professional."

-Al Beuster, Director, Industrial Support Directorate Joint Munitions Command

PARTNERING TO MEET SUSTAINABILITY OBJECTIVES

In many cases, the complex ESOHE challenges the DoD faces require multi-disciplined, proactive and participatory solutions. For example, leveraging the success of the Installation Sustainability Planning (ISP) process demonstrated at multiple single installations in years past, the NDCEE brought joint working teams together in Hawaii to successfully apply the ISP process at the regional scale in FY09. The NDCEE also continued to develop and demonstrate a unique community engagement model at Fort Bragg and successfully implemented public participation tools for Formerly Used Defense Sites in Florida. Highlighting both the need and our ability to address integrated ESOHE challenges, the NDCEE identified infrastructure technology options that will improve worker safety and health while simultaneously reducing energy consumption at the Marines Corps Logistics Base Barstow. New policy directives, such as the recently signed Executive Order 13514, underscore the expectation for federal agency leadership in all areas of sustainability. The NDCEE will continue to play a vital and expanding role leveraging our diverse project experience, technical expertise, and established relationships to enable the DoD to meet these expectations.

"The NDCEE team has provided the personal initiative and thoughtful expertise necessary for Fort Bragg to engage outside the fence in ways that would otherwise not be possible."

-Paul Wirt, Fort Bragg Department of Public Works, Environmental Branch Chief



TECHNOLOGY TRANSITIONS

Identifying, developing, and evaluating technologies, tools, and processes and providing transition support is the mission of the NDCEE. Technology transition does not necessarily occur at a single point in time, but rather it is the comprehensive set of activities by which a potential solution is fully vetted and inserted for a specific military application. In some cases, just as important to this process is the knowledge gained from those alternatives that were explored but didn't work, as well as those solutions that ultimately succeed. In FY09 the NDCEE performed value-added activities in all the phases of the transition process – Assessment, Development, Demonstration/Validation, and Transition – as shown by the examples below.

Assessment (TRL 1-8)

Traditional literature searches, data mining, surveys, studies, and other methods are employed in this phase to identify available alternatives, explore research opportunities, or track emerging technologies. Potential aspects include understanding the problem, context, drivers, and end-user needs; obtaining available technical, economic, and ESOHE data on current and alternative technologies; and utilizing information gained to focus technology transition efforts.



A detailed assessment was conducted to down-select technologies for reforming JP-8 to enable its use as a feedstock for fuel cells

Development (TRL 1-5)

This phase includes those activities involved in the evolution of scientific concepts and research towards tangible technical solutions, including: preliminary design, system or process development and fabrication, computer modeling, and bench-scale or laboratory testing.



A Modified Decomposition Hydrolysis System is being developed to allow safe and effective disposal of explosives residue found on range scrap

Demonstration/Validation (TRL 6-8)

This critical phase includes all activities associated with testing and evaluating potential technology alternatives against user requirements. Whether at the prototype- or full-scale level, demonstration/validation testing can encompass a variety of evaluation objectives including feasibility, optimization, and/or operational acceptance testing.



Laser-Induced Breakdown Spectroscopy (LIBS) was demonstrated at Ft. Rucker, AL, to identify lead-free solder in circuit boards.

Transition (TRL 9)

The final phase of the technology transition process may include implementation, start-up, training, and/or other support efforts necessary to field validated technologies for installation and weapon system end users. Now the technology is ready for operational military use at the end user's discretion.



Corn-Hybrid Polymer (CHP) Blasting transitioned to Fort Wainwright, AK



Field Injury Tracking Support (FITS) tool transitioned to Fort Jackson, MS



Numerical Process Model for Flowformed Mortar Tubes transitioned to Benét Laboratories, Watervliet Arsenal, NY



Personal Fitness Tracker transitioned to the U.S. Military Academy, West Point, NY



Vision Strategist Tool for Roadmapping transitioned to Tank Automotive Research Development and Engineering Center (TARDEC), Warren, MI



Three zero energy technologies, solar fan, radiant barriers, and ceramic paint additive, transitioned to Aliamanu Military Reservation, HI



Three paint application technologies, HVLP spray gun, LaserPaint™, and squirrel-cage mixer transitioned to Anniston Army Depot, AL; LaserPaint transitioned to Fort Wainwright, AK



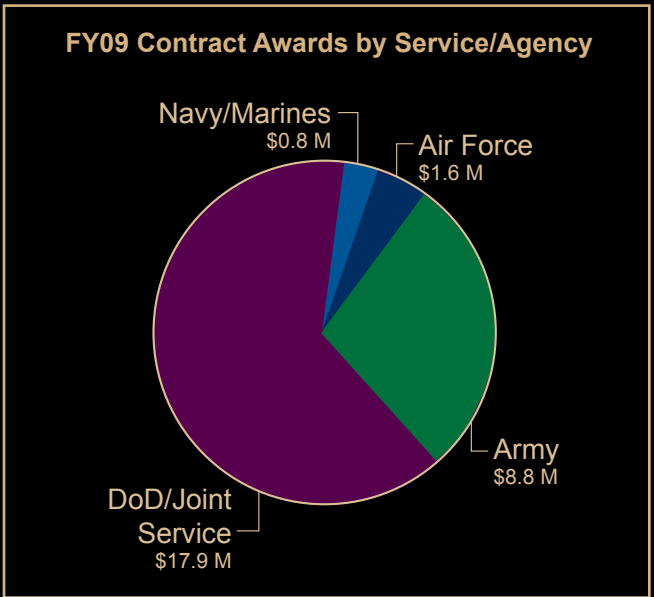
Single Component Chemical Agent Resistant Coating (CARC) transitioned to Anniston Army Depot, AL, and Fort Wainwright, AK; Water Dispersible CARC transitioned to Fort Wainwright, AK

OPERATIONAL STATISTICS

In FY 09 the NDCEE continued the critical mission that it began in 1991: identifying, demonstrating, evaluating, and fielding technologies in support of DoD readiness, sustainability, and the warfighter. In support of this mission, the NDCEE served more than 100 client and stakeholder organizations in FY09, and total dollars on contract increased by \$29.1 million.

The NDCEE initiated 34 new task orders, completed 42, and ended FY09 with 182 task orders and \$203 million in contracts, thanks in part to many returning reimbursable clients. As shown in the graph "FY09 Contract Awards by Service/Agency," the NDCEE performs work across the DoD and DoD agencies and supports other federal agencies. The NDCEE averaged 145 client deliverables a month. Average on-time delivery was 99%. The NDCEE is required to disseminate deliverables to appropriate DoD organizations to ensure that information is shared among applicable U.S. government agencies and private industry, and in FY09, 258 deliverables were uploaded to the Defense Technical Information Center (DTIC) to make this information available.

In addition to serving a diverse client base, the NDCEE strives to achieve diversity with regard to subcontracting, especially in compliance with Public Law 95-507 that encourages the use of small and disadvantaged businesses in federal contracting. In support of these socioeconomic goals, to date, 56.3% of subcontracting dollars have been to small businesses, including small disadvantaged businesses and woman-owned small businesses.



The NDCEE is working across the U.S. Army, Navy, Air Force, Marines, and Department of Defense. This chart shows the percentage of FY09 contract awards supporting each client.

OUTREACH ACTIVITIES

NDCEE outreach activities directly support technology transition by disseminating information on ESOHE technologies to audiences within the DoD and across other federal agencies. Extending the base of knowledge is an important part of the NDCEE's role. In FY09 NDCEE outreach activities included:

- Exhibiting and presenting at seven ESOHE conferences. Technology demonstrations were featured in the NDCEE booth and subject matter experts contributed technical presentations and posters.
- Production and distribution of program publications including Winter/Spring and Summer/Fall Newsletters, Capability Summary, FY08 Annual Report, FY08 Technologies Publication, Task Descriptions, and Technology Fact Sheets
- Continuing upgrade and population of the NDCEE web site (www.ndcee.ctc.com)
- Hosting two Information Exchanges including the Sustainable Installations Information Exchange: Hawaii Military Energy Initiatives held on February 27, 2009 on Aliamanu Military Reservation, HI and the Environmental Management Information Systems Users Group meeting held in Washington, DC and via teleconference on August 27, 2009.
- Conducting a DoD-wide NDCEE Program Review held on April 14-15, 2009 in Arlington, VA.
- Submitting six articles related to NDCEE task accomplishments to military and technical publications (two published, others pending publication).

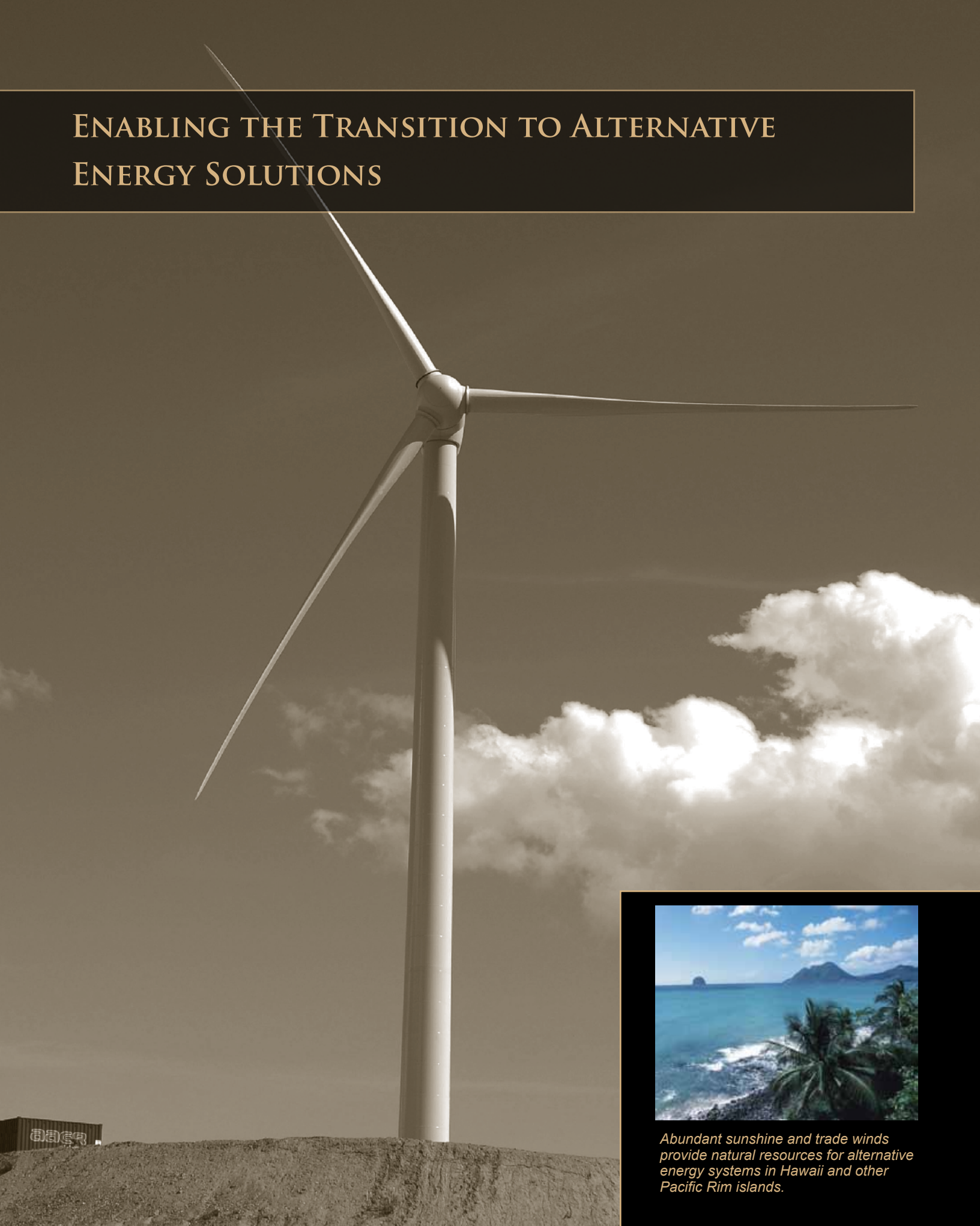


Attendees of the Sustainable Installations Information Exchange were invited to see (and feel) a unique house coat demonstrated on military housing. For the demonstration, a ceramic paint additive was added to house paint to create a coating that radiates solar and ultraviolet rays back into the atmosphere.

This annual report provides highlights of several NDCEE projects that encompass many of our capabilities and services. The NDCEE is committed to delivering quality solutions to address our clients' mission-critical requirements and we invite and encourage you to take advantage of our offer – How Can We Support Your Mission?

FOR ADDITIONAL INFORMATION, PLEASE VISIT WWW.NDCEE.CTC.COM

ENABLING THE TRANSITION TO ALTERNATIVE ENERGY SOLUTIONS



Energy has become a central issue for the DoD as multiple regulatory and policy drivers motivate reducing petroleum use and increasing the use of renewable energy. Furthermore, as the link between energy and environmental issues is increasingly recognized, so expands the NDCEE's role in supporting the DoD's pursuit of alternatives meeting regulatory, energy security, efficiency, and economic requirements. For the warfighter, more energy-efficient technology translates into enhanced operational security and success on the battlefield. Toward this end, the NDCEE is supporting the DoD through policy and strategy development, as well as through demonstrations of innovative energy technologies, alternative energy products, and assessment and measurement tools.

DESIGNING AND BUILDING COST-EFFECTIVE, ENERGY-EFFICIENT FAMILY HOUSING

The NDCEE and Actus Lend Lease are working together to design and build cost-effective, energy-efficient military housing. The DoD provides more than 300,000 homes for uniformed personnel and their families, and it is committed to providing these families with housing that maximizes occupant comfort and well being while minimizing energy and maintenance requirements. In recognition of that commitment, the team evaluated sustainability strategies to improve energy efficiency in newly constructed family housing at Aliamanu Military Reservation, HI. The lessons learned there have been applied to housing in Fort Campbell, KY.

The Aliamanu demonstration involved two-story duplex houses that were on the same street, with the same orientation, and similar size. The demonstration featured solar attic fans for ventilation, house coatings that contain reflective additives to reduce solar heat gain, and radiant barriers that reflect radiant heat rather than absorb it. These technologies were selected based on results from energy modeling and a lifecycle cost analysis in which

15 low-cost, high-energy performance technologies and strategies were ranked by performance and cost.

The demonstration showed that these low-cost strategies may reduce the electrical load of a house while meeting or exceeding the needs of service members and their families. The demonstration also revealed that energy modeling is more useful when applied in the conceptual, schematic, and design development stages of a design. At these stages, energy modeling results of different options, such as building orientation, can be analyzed for impacts on energy savings as well as for initial and lifecycle costs of the project. Once construction starts, options become limited. These lessons were applied at the Fort Campbell demonstration involving a housing project that began at the conceptual stage.

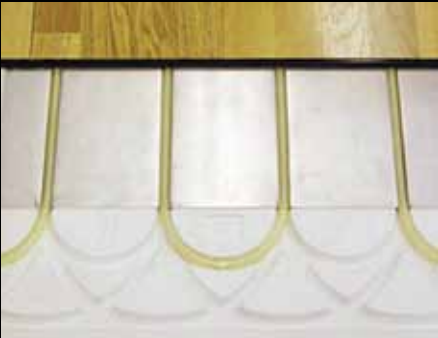
OPTIMIZING DOD'S RENEWABLE ENERGY OPTIONS

DoD installations are seeking technologies to reduce energy consumption in their facilities while at the same time replacing fossil fuels with renewable energy sources. The NDCEE is working with several DoD entities to develop and demonstrate alternative and renewable energy sources, such as geothermal, wind, and solar. At Fort Indiantown Gap (FTIG), PA, the NDCEE is working with the Pennsylvania Army National Guard (PANG) and the National Guard Bureau (NGB) Headquarters to conduct a geothermal energy demonstration. In Hawaii, the NDCEE has teamed with Ohana Military Community to demonstrate a wind turbine for generating electricity at the Navy's Pearl City Family Housing Site. A solar radiant heated flooring demonstration is also planned at the Pohakuloa Training Area.

As part of sustainable energy demonstration projects, the NDCEE completes a technology and economic assessment on a variety of alternative energy technologies to determine the best option given the building, energy usage, climate, and cost variables. At FTIG this



Abundant sunshine and trade winds provide natural resources for alternative energy systems in Hawaii and other Pacific Rim islands.



Solar thermal radiant floor heating combines hydronic radiant floor heat with solar thermal water heating to capture the sun's warmth throughout the day and distribute it throughout the radiant flooring system when it's needed, primarily at night.



Demonstrated at Aliamanu Military Reservation, radiant barriers are an alternative to conventional insulation used in houses. These barriers reduce summer heat gain and winter heat loss, making military houses more energy efficient.



The NDCEE geothermal technology demonstration at Fort Indiantown Gap will help PANG achieve energy-independent facilities, one of its five strategic objectives for facility sustainability. This photo shows workers installing horizontal and vertical pipes for the heat pump system.



The demonstration and validation of biodiesel use involves sampling of fuel quality within tactical vehicles as well as storage facilities and monitoring of maintenance records. Testing is done under a wide range of operating conditions.

assessment concluded that a geothermal heat pump system was the best option. Geothermal heat pumps use the constant temperature of the earth as an exchange medium instead of ambient air. These systems generate little air and water pollution, require less land than other alternatives, are durable and cost-effective, and have proven viability in many climatic conditions. A geothermal system was installed at FTIG in June 2009. Data collected over a 12-month period from both the test and control building will cover FTIG's full range of temperature conditions. The data will help determine if geothermal heat pump systems provide FTIG with lower life-cycle costs than traditional split system air-conditioning/propane gas furnace heating systems. The information can then be used to support decision-making as the DoD continues to invest in renewable energy technologies.

DEMONSTRATING AND VALIDATING BIODIESEL USE IN TACTICAL VEHICLES

The ability to use biodiesel (B20) in tactical vehicles and equipment increases the DoD's use of a renewable fuel, improves fuel supply and operational flexibility, reduces greenhouse gas and regulated air emissions, and potentially reduces long-term fuel costs. The NDCEE is supporting an Environmental Security Technology Certification Program (ESTCP) Field Demonstration which is testing biodiesel use in non-combat tactical vehicles to further develop this fuel option. Test vehicles are located at Naval Base Ventura County, CA; Marine Corps Air Ground Combat Center Twentynine Palms, CA; Naval Surface Warfare Center Crane, IN; and Moody Air Force Base, GA.

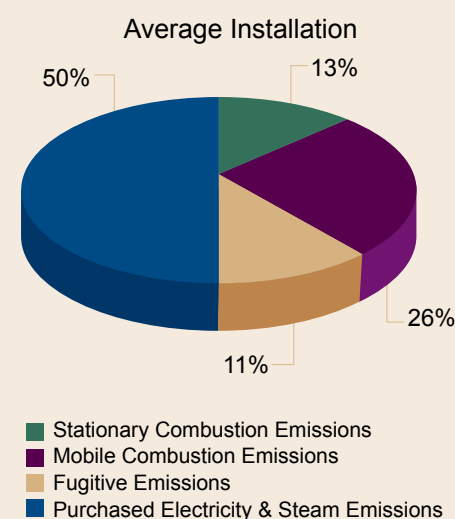
The demonstration and validation of biodiesel use in tactical vehicles compares test vehicles using B20 with similar control vehicles operating on JP-8 for a period of twelve months. The demonstration sites and vehicles were chosen to cover a wide swath of climatic and operating conditions. Maintenance, vehicle, and climate data are being collected. The testing will validate DoD

operational parameters and the ability of B20 to provide for trouble-free operations. The demonstration is also designed to provide data to evaluate the storage limits of B20. Procedures, validated technologies, and lessons learned will be summarized to identify the critical variables affecting the use of this fuel for more controlled, future demonstrations. The overall objective is to ensure that Commanders have vehicles that are capable for immediate deployment and performing mission-critical tasks with minimal fuel-related maintenance and related risks.

DEVELOPING MEASUREMENT AND REPORTING TOOLS FOR GREENHOUSE GASES

The DoD and other federal agencies are actively learning how to manage and reduce greenhouse gas (GHG) emissions in response to existing policies and emerging regulations. One of the first steps in this process is to develop an emissions inventory to identify the GHG emission sources, types, and amounts. The NDCEE demonstrated a bottom-up GHG inventory approach for Army installations that leverages a web-based Environmental Management Information System (EMIS).

To conduct the inventory, the NDCEE team visited ten Army installations to identify GHG emissions from a variety of sources. The NDCEE collaborated with representatives from installation compliance, environmental, public works, maintenance, manufacturing, and vehicle management to identify sources and collect data necessary to quantifying emissions. The demonstration showed that purchased electricity accounts for approximately half of an average military installation's GHG emissions. However, this amount can vary greatly depending on the installation's mission. Information of this nature can help focus GHG management strategies for reduction of GHG emissions, to include energy conservation, alternative energy sources, and carbon sequestration.



MEASURABLY IMPROVING HEALTH, SAFETY, AND READINESS



Injuries are the biggest health challenge confronting U.S. military forces in peacetime and combat operations, resulting in over 1.8 million medical encounters annually across the Services and affecting more than 800,000 individual Service members. These injuries place a significant demand on the military healthcare system and reduce personnel availability and force readiness. Injuries result in an estimated 25 million days of limited duty among Service members annually. The National Safety Council estimates that preventable mishaps cost the DoD approximately \$3 billion annually with additional indirect costs estimated at nearly \$12 billion. The NDCEE supports two key DoD readiness programs targeted at enhancing warfighter health and well-being and the safety of military workplaces: implementation of Defense Safety Oversight Council (DSOC) initiatives and operation of the DoD's Voluntary Protection Programs Center of Excellence (VPP CX).

ADDRESSING OCCUPATIONAL HEALTH AND SAFETY CONCERNS

Previous research conducted by the NDCEE in support of the DSOC found the top five occupations with the highest loss in productivity to be: Fire Protection and Prevention; Police; Maintenance Mechanic; Motor Vehicle Operators; and Rigging (Navy). These occupations constitute only 4.4% of Full-Time Equivalents within the civilian sector

of the military, but contribute to 12.2% of mishaps and 16.6% of Total Lost Days. This information has guided the DSOC Task Forces as they seek to improve safety in the workplace. For example, in FY09, the NDCEE developed a 90-minute, multimedia training module for firefighters to address the most significant causes of injuries in this occupation: entering and exiting the fire apparatus; slips, trips, and falls; and injuries resulting from heavy lifting. The courseware is compatible with and available to each Service's Learning Management System. The Navy has been using it for about a year and intends to make the course mandatory for all new firefighters and an annual requirement for all firefighters.

Through the VPP CX the NDCEE continues to support improvements in workplace health and safety at more than 165 military installations and Defense agencies. The VPP CX researches and evaluates best practices and performance metrics for implementation, provides on-site assistance and remote telephone support, conducts training workshops, and presents monthly web-supported training. Specialized support is provided to some installations requiring additional assistance. For example, the NDCEE is providing industrial hygiene support to Crane Army Ammunition Activity (CAAA), IN, after a mock audit and on-site evaluation identified gaps in their safety and health management systems.



U.S. Army Garrison-Kaiserslautern is recognized as an "Army Star Strong" worksite by the Office of the Assistant Secretary of the Army for Installations & Environment.

The DoD celebrated other VPP milestones in FY09. The U.S. Army Garrison Kaiserslautern was the first program outside the continental U.S. to achieve VPP Star status. In addition, Fort Indiantown Gap Army National Guard (ANG) Army Aviation Support Facility near Annville, PA was the first ANG Activity to be recognized as a VPP Star site. To date, more than 30 DoD sites have received VPP Star recognition.

REDUCING AIRSPACE MISHAPS

According to the DoD, more than 275 Service members have perished in aviation mishaps between fiscal years 2004 – 2008. Nearly 250 aircraft were also lost during that period, resulting in a direct cost to DoD of over \$1.5 billion. The NDCEE has focused on key areas that contribute to aviation mishaps: reducing Gravity Induced Loss Of Consciousness (GLOC), reducing human error driven by conflicted airspace and adverse operational environments, and strengthening critical risk management systems.

GLOC continues to be a challenge for pilots of military aircraft who are subjected to high gravitational (G) influences during maneuvers. G-Suits worn by pilots have proven to be effective in minimizing the negative

gravitational effects, but the designs have remained relatively unchanged since they were introduced decades ago. The aviation community has identified improvements to make the suits more friendly in the operational environment and effective at minimizing GLOC. As a result, the NDCEE and the USAF Air Combat Command (ACC) conducted side-by-side testing of two different configurations of G-Suits to identify the recommended full coverage design based on a scientific dem/val approach and feedback from military pilots flying F-15C and F-16 aircraft in more than 180 sorties.

Improved information quality and accessibility can reduce risks for mishaps in airborne training and exercises. Thus, the NDCEE is developing two information management tools in support of the DSOC Acquisition and Technology Program Task Force's initiatives for aviation safety improvements. The Joint Low-Level Deconfliction Tool (JLLDT) offers pilots and schedulers the ability to reduce the risk from training conflicts below 1,500 feet. Scheduling data from two sources – the Federal Aviation Administration and the Military Airspace Data Entry – are accessed and displayed in a graphical format that can be readily interpreted. The software and website were positively received by the Pentagon Airspace and Range Council, who recommended continued development to expand the JLLDT's capability.

The Joint FlyAwake Initiative focuses on aviation mishaps caused by fatigue. The existing fatigue modeling software (FAST) is technically excellent but unusable by field unit aviators and schedulers due to the software interface. The FlyAwake modeling software developed by the NDCEE is designed to make fatigue modeling results available, automated, and simple to understand. This was accomplished by using feedback from flight surgeons, physiologists, researchers, pilots, and schedulers. The work/sleep estimates in the model are being validated by the Walter Reed Army Institute of Research using



A military police officer stops a motorist for speeding on base at Camp Pendleton, CA. DoD private motor vehicle fatalities have declined from 238 deaths in 2002 when the DSOC baseline was established, to only 141 at the close of fiscal year 2009. Even though the number of deaths have been cut by more than 40%, motor vehicle mishaps still remain the number one non-combat killer of our men and women in uniform.

actigraphy measurements of volunteer aircrew. Actigraphy is a non-invasive method of monitoring human rest/activity cycles by measuring gross motor activity. These measurements will improve the quality of the FlyAwake modeling along with the improved user interface.

REDUCING LOST TRAINING TIME

Improved information quality and accessibility can also reduce lost training time. In support of the DSOC Military Training Task Force, the NDCEE developed a hand-held, web-based, injury and illness recording and tracking system. This tool, called the Field Injury Tracking Support (FITS) tool, allows soldier injury or illness information to be captured electronically while training in the field. This information is then linked to other key points in the injury management process – from the drill sergeants and company commanders to the medical community. Dashboard access to this accurate and readily available data on the type of injuries, as well as where and when they occur, will help leaders focus initiatives to reduce future injuries, number of lost training days, and recruit attrition. Full-scale testing was successfully conducted at Fort Jackson, SC, resulting in implementation of the tool installation-wide in May 2009.

Efforts to mitigate lost training time from injuries can begin prior to training. Lack of physical readiness is a common risk factor and contributor to overuse injuries during basic combat training (BCT). To help improve physical activity, fitness, and readiness prior to arrival at basic training, the NDCEE developed the Personal Fitness Tracker. Based on the requirements of stakeholders at the U.S. Military Academy, West Point, NY, this web-based software module allows incoming cadets to document daily physical activity and provides them with recommendations for aerobic training, muscular strength, and endurance. Results for participants in the program showed a 14%

improvement in initial Army Physical Fitness Test results. Results also showed that non-participants were 52% more likely to be injured during BCT than program participants.

REDUCING RISKS FROM DRIVING MISHAPS

Private motor vehicle (PMV) fatalities, the leading cause of accidental deaths for all Services, average nearly 300 per year and result in over \$100 million per year in direct fatality cost. The indirect costs and readiness impacts are significantly higher. Information management can prove valuable for reducing PMV fatalities. The NDCEE assisted the DSOC PMV Task Force in developing and demonstrating a Driver History Pilot (DHP) involving nearly 3,000 personnel on twelve Navy ships. Studies have shown that simply monitoring driving records of individuals can reduce the likelihood of that individual engaging in at-risk behavior. The DHP software tracks leading indicators and provides reports of off-base driving violations. The pilot was successfully completed with voluntary participation and interventions were proposed based on the type of traffic violations identified.

RESPONDING TO REAL-TIME WARFIGHTER NEEDS

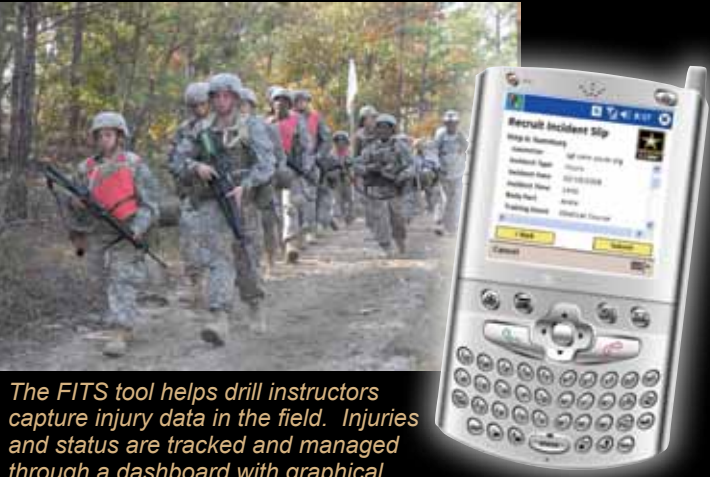
The NDCEE is working with the DSOC Deployment and Operations Task Force and U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) to test ergonomic seat cushions as a countermeasure to decrease the incidence of back injuries and the resulting lost road time. In FY09, the NDCEE defined the issue, developed an approach to collect and analyze data and coordinated with a unit in-theatre to support the testing. The ergonomic seat pads and transducers to measure

vibration exposure levels were purchased and installed in High Mobility Multipurpose Wheeled Vehicles (HMMWV) of the 4th Sustainment Brigade, 1st Theatre Support Command Camp Arifjan, Kuwait. Medical pre-screening was conducted to facilitate test group and control group comparisons. Initial

feedback from the seat users was positive and final test results will determine the extent to which the seat pads are deployed.



JLLDT interface clearly warns pilots of potential conflict on their scheduled missions. It includes yellow warning triangle icons on the map and in a summary box with details. The tabular interface also displays the mission conflict data in a very easy to use user interface.



The FITS tool helps drill instructors capture injury data in the field. Injuries and status are tracked and managed through a dashboard with graphical displays and reporting capabilities.

REDUCING THE ENVIRONMENTAL BOOTPRINT AND OPERATIONAL COSTS



From its inception, the NDCEE has helped the DoD reduce its environmental footprint and costs associated with weapon system acquisition, operation and maintenance, and installation management. This assistance has resulted in reduced utility consumption and hazardous material usage, increased productivity and enhanced product performance, less waste for treatment and/or disposal, and improved regulatory compliance. Examples of NDCEE support provided to the DoD and other Federal agencies in FY09 include: validation of an improved soil sampling method; transition of technologies to enhance coating/coating removal operations; testing of commercial anti-icing materials; evaluation of costs and risks associated with the use of hazardous materials; deployment of environmental stewardship training to learning management systems; and optimization of flowforming for cost-effective manufacturing of nickel alloy mortar tubes.

VALIDATING A LESS EXPENSIVE SOIL SAMPLING METHOD FOR DOD RANGES
DoD Directive 4715.11 requires each DoD component to assess environmental impacts of munitions use on operational ranges. Traditional sampling methods for DoD assessments involve collecting a few discrete or composite

samples for an area of concern and submitting them for laboratory analysis. The NDCEE demonstrated and validated an improved sampling and analysis approach called Multi-increment[®] sampling (MIS) that reduces assessment costs and provides more accurate data to characterize explosives contamination in soil. It differs from a traditional soil sampling technique in two ways: (1) the number of increments (grabs) is much greater; and (2) the entire area of interest is represented by each sample.

The NDCEE demonstrated MIS at Holloman Air Force Base, NM, and Fort Lewis, WA. The MIS methodology was compared to three traditional (discrete, box, and wheel) methods of sampling munitions residues. All soil samples were tested in compliance with EPA Method 8330B. The NDCEE also compared the cost of three replicate MIS samples to thirty discrete samples, both representing comparative data sets. Based on the cost of field labor and laboratory analysis, the thirty discrete samples cost 189% more than the three MIS samples. There are also indirect cost benefits that result from high confidence in the reproducibility of the MIS data. Our demonstration findings support broader use of MIS in the DoD.

Multi increment[®] is a registered trademark of EnviroStat, Inc.

ENHANCING COATING/COATINGS REMOVAL OPERATIONS

Conventional chemical agent resistant coating (CARC) contains hazardous air pollutants (HAPs) and volatile organic compounds (VOCs). To help installations transition to alternative CARC formulations, the NDCEE conducted technology demonstrations at Forts Benning and Stewart, GA; Anniston Army Depot (ANAD), AL; and Fort Wainwright, AK. Tests conducted by the NDCEE show that military installations can reduce air emissions by up to 65%, reduce material usage by up to 40%, and lower application times by up to 35% by transitioning to alternative CARC formulations. Following the NDCEE demonstrations, all of the host sites made the transition to the improved CARCs.

The NDCEE structured the demonstrations to allow installation personnel to test supplemental technologies that also may enhance pre-painting surface preparation, mixing, and application operations. Army and Georgia National Guard personnel were trained on the proper use of application equipment and spray techniques. Several technology transitions subsequently occurred including: high-volume, low-pressure spray guns; LaserPaint[™] guidance devices; and corn-hybrid polymer blasting. In addition, all four installations are considering procurement and installation of a water blast system.

In the area of coatings removal and de-painting, efforts were launched to find cost-effective chemical strippers that do not contain HAPs, specifically focusing on elimination of a methylene chloride-based paint stripping solvent currently utilized at ANAD. The NDCEE coordinated testing of three HAP-free paint stripping solvents with ANAD and the Army Research Laboratory, MD. By switching to a HAP-free stripper, it is estimated that ANAD will reduce its operating and maintenance costs by up to \$1.5M annually and provide a safer worker atmosphere

due to the elimination of HAP emissions and a 75-89% reduction in VOC emissions, depending on the solvent selected.

IMPROVING RESULTS FOR MILITARY AIRPLANE DE-ICING

Anti-icing fluids keep aircraft from accumulating additional ice and requiring repeated deicing before takeoff. Use of these fluids provides additional “hold over time” from the time the aircraft is first deiced. These fluids also decrease the use of propylene glycol, which contaminates stormwater runoff and poses a significant environmental threat to surface and groundwater due to its Biological Oxygen Demand and toxic effects, thus potentially decreasing legal liability as well as regulatory compliance costs.

Several anti-icing fluids are available on the commercial market; however, these chemicals had not been tested for compatibility with military aircraft systems and deicing and anti-icing equipment until recently. The NDCEE performed a material compatibility study based on the Aircraft and Runway Deicer Joint Test Protocol. Results of the tests conducted by the NDCEE for 12 material categories will assist weapon system Program Managers in approving the use of those anti-icing fluids that performed as well as propylene glycol and can be implemented as a drop-in replacement using current deicing equipment. By reducing manpower requirements for repeated deicing events, approved anti-icing fluids will improve warfighter readiness in cold weather conditions, both in the U.S. and abroad.

REDUCING CHEMICAL AND MATERIAL RISKS AND IMPACTS TO THE DOD

The NDCEE supports the management of hazardous chemicals and materials for the DoD through research



The NDCEE demonstrated MIS at two diverse ranges—a live-fire bombing range with arid, sandy soils and a shoulder-fired grenade range with humid, sandy loam soils. Demonstration findings proved that MIS results are more precise and accurate than current methods.



Three HAP-free strippers were applied to various ground vehicle parts at ANAD to determine potential performance and cost benefits. The basket shown contains steel locking plates, which were completely stripped of their MIL-C-22750 coating by a water-based, acid-activated stripper at a rate comparable to the current solvent.



The NDCEE conducted material compatibility testing of anti-icing fluids – enabling the use of drop in replacements that will reduce the use of propylene glycol, improve the efficiency of aircraft deicing operations, and enhance military readiness.



Petroleum based jet fuels, including JP-5 and JP-8, are the main source of naphthalene in DoD operations. Measures that effectively control jet fuel and inadvertent jet fuel releases will also inherently control naphthalene. The status of naphthalene was recently downgraded from DoD's Emerging Contaminant "Action List" to the "Watch List" based on NDCEE assessment findings allowing DoD to focus on other, high priority contaminants.

and analysis as well as demonstration and validation. In support of the Office of the Secretary of Defense (OSD), Chemical and Material Risk Management Directorate (CMRMD), the NDCEE recently completed Phase II Risk Assessments on beryllium and naphthalene. Risk Management Options (RMOs) were then developed through an assessment process that evaluates risks in key aspects of DoD critical functional areas. The RMOs were presented to the Emerging Contaminants Governance Council (ECGC) – a group of senior DoD representatives from the readiness, logistics, acquisition, research, environment, and safety and occupational health communities – for action. Based on the NDCEE research, the ECGC endorsed RMOs to limit workplace exposure to beryllium and reduce the level of concern associated with naphthalene.

EDUCATING FEDERAL AGENCIES ON ENVIRONMENTAL STEWARDSHIP

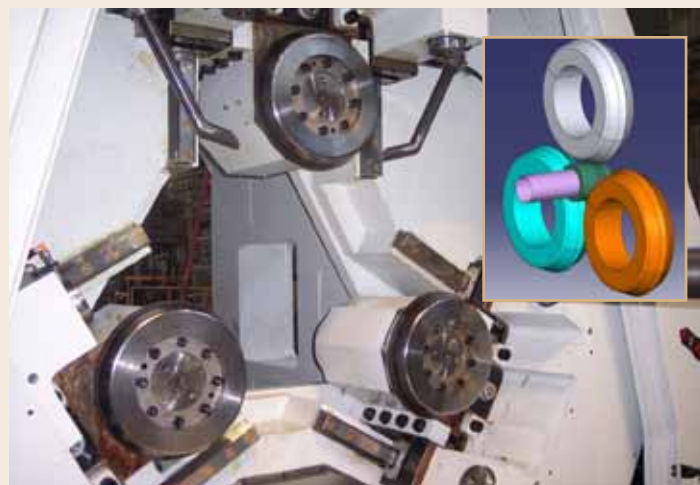
All federal agencies are accountable for environmental stewardship – their responsibilities go beyond regulatory compliance. These responsibilities have been articulated as requirements in multiple Executive Orders (EOs) and most recently consolidated into EOs 13423 and 13514. The NDCEE's expertise in enabling the DoD to meet these requirements has carried over to other federal agencies, including the Department of Commerce (DOC). In FY09, the NDCEE developed and implemented an hour long online and interactive Environmental Stewardship Training module to be given to DOC personnel and ultimately deployed to its Learning Management System. The training covers the basic environmental issues facing the U.S. today as well as the specific goals set out by EO 13423 in areas of environmental management systems, transportation, energy, water, and waste. Final delivery included updates based on EO 13514, which reinforces and expands upon the existing EO goals.

This awareness training will enable the DOC to reduce its environmental footprint and operational costs as it complies with the EOs.

ENABLING ADVANCED MANUFACTURING TECHNIQUES FOR MORTAR TUBE PRODUCTION

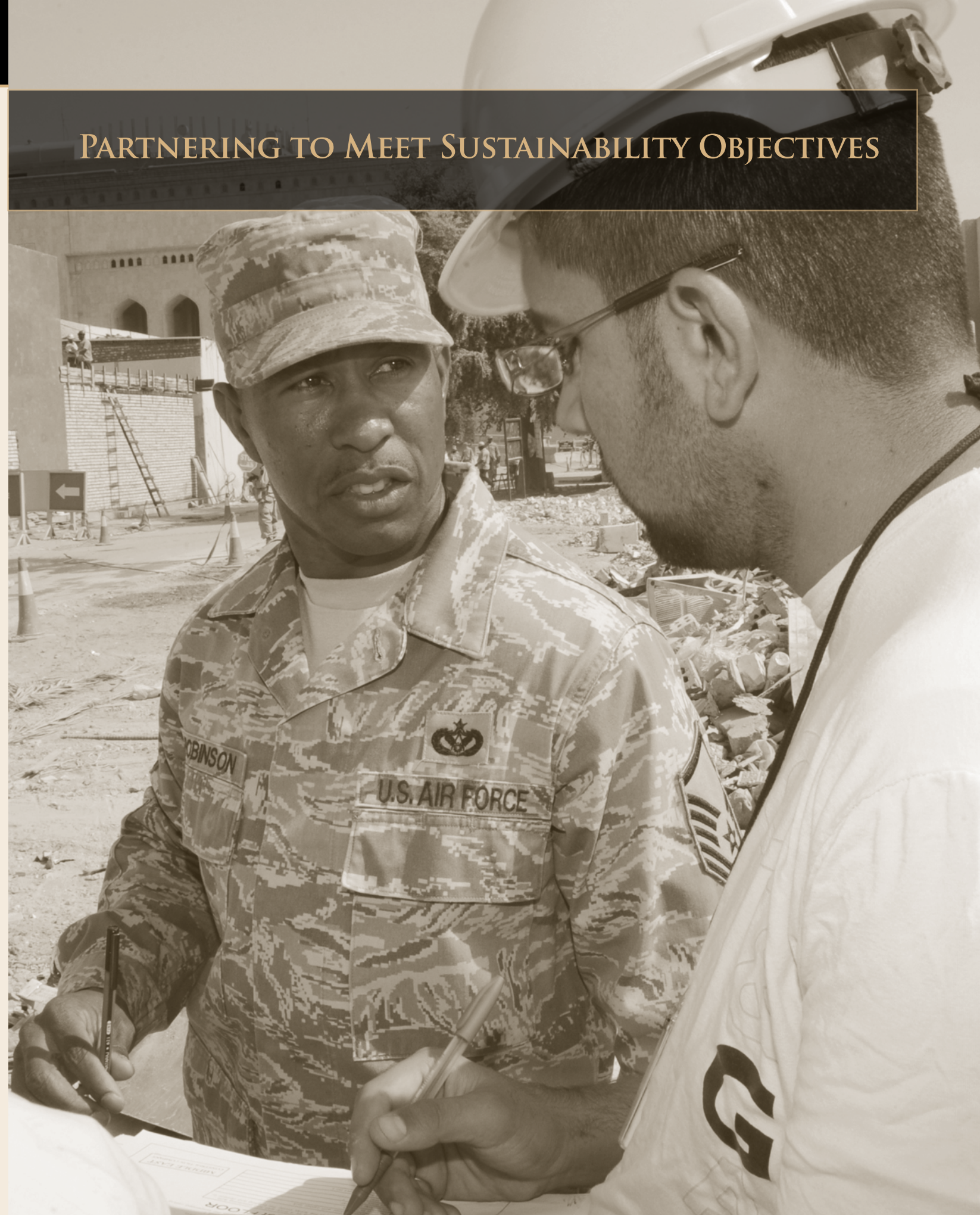
The NDCEE is working with Benét Laboratories, the U.S. Army Research, Development and Engineering Command (RDECOM), Watervliet Arsenal (WVA), and the U.S. Army Tank-automotive and Armaments Command (TACOM) to develop a cost-effective solution for manufacturing flowformed mortar components. Flowforming is a relatively new manufacturing technique that is ideally suited for production of a new, nickel alloy based mortar tube that will reduce the overall weight of the weapon by 10% and increase its strength – both critical issues for the warfighter. Additionally, the process reduces the cost of manufacturing mortar tubes by an estimated 90% as compared to traditional machining and forging.

Flowforming is a process that requires large material deformation, which is difficult to predict. The standard approach is trial and error production on the factory floor, which takes time and consumes resources. The NDCEE team developed a process modeling and simulation tool in ABAQUS to optimize start-up production of flowformed components. The model was transitioned to WVA in June 2009, including training of Benét personnel. Additional efforts are on-going in providing a second model for smaller bore mortar tubes. It is expected that the Army will realize even greater cost avoidance with each additional model due to the fact that material studies and lessons learned will transition smoothly across platforms.



Using the flowforming process (Watervliet Arsenal flowforming machine shown left) is estimated to reduce the cost of manufacturing mortar tubes by 90%. The NDCEE is modeling the process to reduce production start-up time and costs (NDCEE simulation shown upper right).

PARTNERING TO MEET SUSTAINABILITY OBJECTIVES



Complex problems in energy, environment, safety, and health are often interconnected and may affect the DoD's mission in ways that are not readily apparent. To address these challenges most effectively, a holistic, proactive, and participatory perspective is required. This perspective allows the DoD to appreciate the connections, expand beyond regulatory concerns, implement multi-disciplined approaches, and build unique partnerships. It also enables multiple objectives to be met simultaneously – important in a constrained resource context. Several NDCEE tasks apply this innovative approach. Examples include application of the Installation Sustainability Planning (ISP) process at the regional scale at DoD installations across Hawaii and at a military industrial facility, Radford Army Ammunition Plant (AAP), VA; community engagement at Fort Bragg, NC; public participation tools for Formerly Used Defense Sites (FUDS); and an energy infrastructure demonstration for the Main Crane Way at the Marines Corps Logistics Base (MCLB) in Barstow, CA.

EXPANDING AND ADAPTING
INSTALLATION SUSTAINABILITY PLANNING

Applying sustainability principles to strategic planning is inherently holistic, proactive, and participatory. Using these perspectives, the NDCEE has provided support to various Army installations as they incorporate sustainability into their operations through the ISP process. Sustainability planning at a regional scale – such as across Hawaii – provides opportunities for mutual and multiple installation benefits through information sharing, resource leveraging, avoidance of duplication, and economies of scale.

The principles of sustainability that require cross-functional thinking at a single military installation require not only cross-functional but cross-Service thinking at the regional scale. The need for coordination and partnering

is heightened, and institutional challenges threaten the process. The NDCEE successfully adapted the ISP process to bring joint working teams together in Hawaii to address sustainability issues that require collaboration across the Services and with external partners. The NDCEE focused on enabling the existing Hawaii Joint Inter Service Regional Support Group (JIRSG) to take the lead for the sustainability planning process. The NDCEE helped the Sustainability Working Group (SWG) of the JIRSG identify a coordination structure, share issues and potential solutions, and align on a common set of issues and solutions. A solid foundation was built for the JIRSG SWG as it continues to move forward.

The NDCEE has also been engaged in adapting and applying the ISP to the modernization of military industrial facilities. The NDCEE found that the context of industrial operations requires adjustments to the ISP approach as it supported sustainability planning at Radford AAP. The sustainability team utilized a pollution prevention (P2) and process approach that involved everyone from process operators on the production floor to installation managers. The planning process created an understanding of plant-wide sustainability issues and has helped focus sustainability initiatives. The P2 and process approach allowed the team to focus on low-cost process changes that can be implemented easily and yield immediate results, optimizing production as the plant works toward its sustainability goals.

ENGAGING COMMUNITIES OUTSIDE THE
FENCE

Army installations that have completed the ISP process soon realize that their goals cannot be achieved in isolation from the surrounding communities. The need to engage regional stakeholders and inspire cultural



Information presented visually enables productive communication between the U.S. Army Corps of Engineers and a property owner whose property is located within the boundaries of a Formerly Used Defense Site.

change quickly becomes a part of the installation's sustainability efforts. Unique partnerships are therefore needed, although they are not easily implemented. The NDCEE has provided technical and outreach support to the sustainability efforts of Fort Bragg through a unique public engagement model the installation formed with the NC Department of Environment and Natural Resources (DENR), which evolved into a nonprofit organization called Sustainable Sandhills.

The efforts of Sustainable Sandhills have encouraged the use of sustainability concepts in land use planning decisions, enabled recycling programs in local municipalities, involved local businesses in a Green Business program, and promoted local agriculture. Community engagement is supported through the Community Action Teams (CATs) in each of the eight counties surrounding Fort Bragg. CATs are forums for people with ideas and concerns related to sustainability to identify projects to act on them. Public outreach supported by the NDCEE includes a regional Urban Farm Tour, Green Living and Design Tour, and a Sustainable Film Series. As an early indication of its continuing success, Sustainable Sandhills was recognized by the North Carolina Sustainable Energy Association as its 2009 NC Sustainable Energy Community Organization of the Year. The NDCEE has captured the results of these support activities to provide the Army and the DoD with a model to promote regional sustainability efforts in other regions of the United States.

ENHANCING STAKEHOLDER
COMMUNICATION ABOUT FORMERLY
USED DEFENSE SITES

A participatory and inclusive perspective is particularly important in successful public involvement. The U.S. Army Corps of Engineers (USACE) works with regulatory agencies, elected officials, property owners, and the

public to manage risk and clean up FUDS. The NDCEE has provided critical support to the Jacksonville District of USACE in establishing and maintaining open dialog amongst all interested parties so that concerns are heard and considered before making decisions regarding response actions. The NDCEE supports communication in many ways ranging from preparation of written materials to facilitation of public meetings. The underlying success of these activities is translating extensive technical data into a language and format that can be readily understood by the public. This translation is essential to creating an open communication process, since it respects the range of expertise and motivations amongst those impacted. The NDCEE support is ongoing, and recent accomplishments include preparation of a Statewide Management Action Plan for the 714 FUDS in Florida.

IMPROVING WORKER HEALTH AND
SAFETY WHILE REDUCING ENERGY USE

The NDCEE applied a multi-disciplined approach as it worked with MCLB Barstow personnel to identify potential technology and process improvements for the Main Crane Way (MCW). The project team recognized that indoor environment conditions, worker health and safety, occupant satisfaction, worker performance, building energy use, and the building systems and practices affecting energy use are all interrelated. A whole-building and systems-based approach was therefore applied. Because of this recognition, the NDCEE could identify energy-saving infrastructure improvements that also enhanced indoor environmental quality (IEQ). IEQ issues involve lighting, sound, thermal comfort, ventilation, differential pressure, biological hazards, and particulates, gases, and vapors.

Application of a comprehensive and integrated approach for the MCW required that possible infrastructure improvements were evaluated based on multiple criteria, including economic viability. Technologies or process improvements that would have positive impact in more than one area were given higher scores. Along with the potential to reduce energy use, the ability of the technology or process to improve all aspects of IEQ was considered. The baseline data and recommendations will provide decision-makers within MCLB Barstow and the Marine Corps Logistics Command (LOGCOM) with the information needed to strategically plan infrastructure improvements in the MCW that provide a synergistic solution to its indoor environment and energy use challenges.



As part of their education and outreach efforts, Sustainable Sandhills organized an Urban Farm Tour to promote local agriculture and demonstrate what homeowners can grow on their own properties in urban areas for a more sustainable food supply. The event reached over 350 residents in the counties surrounding Fort Bragg.



Public communication tools developed by the NDCEE help The U.S. Army Corps of Engineers explain the potential risks associated with munitions debris such as these items removed from the Odyssey Middle School near Orlando, FL.



Large, open interior spaces like this crane way at Marines Corps Logistics Base Barstow present heating, cooling and ventilation challenges. There are also indoor air quality issues that impact worker health and safety in these work environments. The NDCEE is supporting an integrated approach to addressing these problems simultaneously.



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